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ABSTRACT

Forecasts of Australian labor market growth, net replacement needs, and net job openings to 2006 are presented using the nine-way grouping of occupations described by (Maglen and Shah, 1999). Analysis is based on classifying occupations by whether they are advantaged by globalization and technological change, relatively insulated, or vulnerable. Globally advantaged occupations are grouped by whether they are, by nature, conceptual or technical. Insulated occupations are in-person professionals, skilled workers, and low-skill workers. Vulnerable occupations are advanced skill, white-collar clerical, blue-collar operative, and manual low-skill. Findings indicate, in the medium term, overall growth in employment is expected to be 1.2 percent per year, and net replacement is expected to be 2.1 percent; turnover will create most job openings for new entrants. More than four of five jobs due to growth in employment are projected to be in the globally advantaged or insulated occupations with projected average growth rates of about 1.7 percent per year; the average for vulnerable occupations is 0.5 percent. Because of job turnover, a substantial number of job openings will be for new entrants in vulnerable occupations, with the net replacement rate of 2.0 percent. Insulated occupations with above average growth in employment have a relatively high rate of turnover, especially among low skill groups. More than one in five of job openings for new entrants is expected in in-person low-skill insulated occupations. Appendixes include a list of 18 references and a paper on replacement demand and growth. (YLB)

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CENTRE FOR THE ECONOMICS OF EDUCATION AND TRAINING

Project 2000-02: Changing skill requirements in the Australian labour force in a knowledge economy

Future job openings: Australia in the knowledge economy

Chandra Shah and Gerald Burke

WORKING PAPER No. 48
April 2003

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- the impact of VET research on policy and practice
- equity and VET
- models for analysing student flows in higher education and in vocational education, and
- returns to investment in enterprise training.

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Executive summary

Maglen (2001) investigated the trends in the Australian labour market over the last decade and a half. He used a ten-way grouping of occupations related to exposure to world trade and to technological change.

This paper is complementary to Maglen's paper and adds to the analysis in two main ways.

- Whereas Maglen looked at past trends we look at the patterns projected for the future.
- Whereas Maglen looked at the change in the numbers employed by occupation we look also at the jobs created by job turnover. This has particular importance for the implications for training, as in some occupations in which employment is projected to grow only slowly there is a high rate of turnover and considerable training is needed for the replacement workers.

Main findings

The analysis is based on classifying occupation according to whether they are advantaged by globalisation and technological change, relatively insulated or vulnerable. The groups of occupations seen to be 'globally advantaged' are further grouped into those called 'conceptual' and 'technical'. Examples of those globally advantaged are many of the professionals and associate professionals in business related occupations. The insulated occupations include many of 'in-person service' professional occupations but also some skilled and low skill occupations for which overseas workers or products cannot be readily substituted. The vulnerable occupations are those whose services, or the products they make, are most subject to substitution from abroad or by new technology and include many manufacturing workers and some groups of white collar workers.

In the medium term overall growth in employment is expected to be 1.2 per cent per year for 2002-06. Net replacement, the jobs resulting from replacement of workers who leave a job net of re-entrants to the occupation, is expected to be 2.1 per cent. Therefore most job openings for new entrants will be created by turnover.

More than four out of every five jobs that are generated because of growth in employment are projected to be in the globally advantaged occupations or in the insulated occupations. These groups of occupations have projected average growth rates to 2006 of about 1.7 per cent per annum whereas the average for the vulnerable occupations is only 0.5 per cent per annum.

However because of job turnover there still will be a substantial number of job openings for new entrants in the vulnerable occupations. The net replacement rate for the vulnerable occupations is 2.0 per cent, just about at the average for all occupations and higher than for most of the globally advantaged occupations. Hence the job openings and the training needs for these occupations are not as low as an analysis confined only to growth in employment might suggest.

The insulated occupations which have above average growth in employment also have a relatively high rate of turnover, especially among the low skill groups of insulated

occupations. More than one in every five of job openings for new entrants is expected in 'in-person' low-skill insulated occupations.

The implications of this analysis for the VET sector include:

- The VET sector should continue to make strategic decisions to develop capacity to deliver training in areas that have potential growth in the future.
- There is little projected growth in some of the vulnerable occupations for which the VET sector is the primary source of training. The vulnerable occupations include most of the traditional trades occupations. But there continue to be substantial job openings for new entrants due to replacement of workers leaving the occupations. It is therefore important for the VET sector to maintain substantial capacity to provide training in these fields.
- There is a need to review the training of persons in low-skill occupations especially in the insulated in-service occupations. These have a very high turnover. Questions to consider are:
  - What resources go into training for these occupations?
  - Is the training provided useful for the occupations many of the persons in these jobs may subsequently enter?
  - Who bears the costs of the training, who receives the benefits and who pays for it: employers, employees and government?

Introduction[1]

This paper presents forecasts of growth, net replacement needs and net job openings to 2006 by the nine-way groupings of occupations first defined in Maglen and Shah (1999). It shows the way demand for labour is likely to be affected by technological change and globalisation.

In this paper we draw on the terminology in Maglen (2001) to describe the nine groups of occupations. We first review the Maglen (2001) classification of occupations. We then discuss some conceptual issues regarding replacement needs and job openings before presenting and discussing estimates of job openings for new entrants to occupations.

Occupational groupings

Maglen and Shah (1999) developed a nine-way grouping of occupations to study the trends in the Australian labour market over the last decade and a half. At the heart of this grouping was the three-way grouping suggested by Reich (1992).

To further provide a context and rationale for the grouping Maglen (2001) considered the extent to which substitution could take place between various types of labour in Australia and in other countries and also between labour and capital in a period of rapid technical change. The extent to which substitution occurs has been increased by changes in the Australian economy and world economy. The most obvious factors have been the reduction in trade barriers and financial deregulation together with new information and communication technologies and the growth of global corporations with new labour resource strategies.

This has meant an increase in Australian workers directly engaged with selling their labour in the world market but, more importantly, Australian workers engaged in the production of goods and services sold on the world market or subject to increased competition in Australia from producers in other countries.

Maglen reviewed Australian occupations on the basis of the likelihood of their being affected by substitution by overseas labour or by capital associated with technological change. He suggested that occupations could be grouped into three major groups, close to the original Reichian classification but with a somewhat different justification, and with several subgroups within each. These are summarised in Figure 1 and discussed below.

Figure 1 Expected levels of substitution in the three-way grouping of occupations

Globally advantaged	Insulated	Vulnerable
Low	*Generally negligible*	*Generally high*

[1] CEET is also preparing a related paper looking at some of the alternative methods and models of analysis of globalisation and employment and the findings in other countries.

Globally advantaged occupations

For finer analyses the group is further divided into occupations whose nature is basically:

1. Conceptual, such as various groups of managers, financial dealers, and various professional groups including scientists, media and arts occupations; and
2. Technical, such as most technicians and other associate professional occupations.

This group has the potential and capacity to interact directly or through corporations with the global knowledge economy. Maglen (2001) states that for this group location in Australia does not create a gap in the 'chain of substitution' that prevents the Australian workers group from competing with workers with similar attributes located elsewhere. By the same token workers located elsewhere are also not prevented from competing in Australia. Nonetheless, there are occupations in which Australians have no perfect match or close substitutes located elsewhere or where Australians have proved to be strong competitors.

Insulated occupations

This group includes

1. in-person professionals such as medical practitioners and school teachers;
2. in-person skilled workers such as real estate workers, community service workers and police officers; and
3. in-person low-skill workers such as waiters, bus drivers, elementary sales and service workers.

At this point in time, given current prices and technology, this group is largely locally based. For this group location in Australia creates a gap in the 'chain of substitution' that prevents the ability of offshore labour from providing effective competition. Also, the personal and/or customised nature of the services they provide gives them a degree of protection from being replaced by technology.

Vulnerable occupations

The group is sub-divided into four sub-groups:

1. advanced skill such as skilled tradespersons;
2. white-collar clerical such as various clerks, secretarial and word processing jobs;
3. blue-collar operative such as machine operators; and
4. manual low-skill, including production assemblers and process workers.

This group consists of occupations that are under threat from technological change and globalisation. Some of the jobs require skills and involve tasks that have a higher chance of being automated in the near future or can be performed with cheaper offshore labour. A lot of these jobs are of a routine production nature. The group covers a range of skill requirements, from specialised trade skills to basic manual skills.

The advanced skill group includes mainly tradespersons. It is possible that some who have a particular skill may largely operate in the domestic market and thus could be regarded as insulated, while others with similar skills could be in an environment that is

exposed to the global economy and their jobs could be vulnerable. Examples of such occupations are those of engineering tradespersons, and meat tradespersons. Maglen (2001) split the advanced skill sub-group into those who are vulnerable (manufacturing trades) and those who are insulated (trades in construction rather than those in manufacturing, which is seen to be vulnerable). We find it problematic to make this division with confidence with the type of data available to us at the present time. This problem can be investigated further as data at a finer level of disaggregation become available.

An extract of some of Maglen's main findings is given in Box 1. The current paper does not replicate the detail by gender and age contained in Maglen's paper. The growth in employment projected in this paper is somewhat different from the pattern of growth that occurred in the past reported by Maglen. And the additional information provided below on replacement shows that the expected pattern of job openings and hence training needs differs to a considerable extent from an analysis based on changes in employment alone.

Box 1. Maglen's findings in the context of this paper

These findings are based on Maglen (2001 pp.2-4) but adapted to the slightly different methodology of the current paper.

- About 60 per cent of the Australian workforce could be said to be employed in global labour markets. The others by nature of their job and prevailing technological constraints are largely insulated from the direct impact of global competitive forces, though they depend for their continued employment upon the purchasing power and preferences of those who are more directly engaged in global labour markets.

- Those exposed to globalisation can be broadly divided between those for whom it has opened up opportunities and those for whom it has posed a threat and has made their jobs more vulnerable. The former group of occupations currently account for approximately 20 percent of Australian workers and the latter around 40 per cent.

- A much greater percentage of male workers are exposed to global labour market forces than are female workers. Proportionately more males are positively exposed but more are also in vulnerable jobs as well.

- The proportion of workers in insulated occupations rose slightly over the last decade and a half and those advantageously exposed also rose slightly. The proportion in vulnerable occupations fell. The strongest growth among the insulated group of occupations was in part-time and casual employment whereas in the advantaged occupations the jobs tended to be full-time.

- Workers with vocational qualifications (at the certificate and diploma level) appeared to be under-represented in the occupations seen to be advantaged by recent change.

- By far the strongest growth in employment in occupations advantaged by global labour market forces has been amongst workers in their middle career years (between the ages of 35 and 54).

- Amongst the advantaged occupations the fastest growth has been amongst information technologists and financial specialists but strong growth has also been experienced in the arts, media and entertainment occupations.

Source: Maglen 2001

Concepts of replacement needs and job openings

Job openings in an occupation are a result of employment growth and the replacement or turnover of workers who leave the occupation. The effects of demand due to replacement of workers is often larger than demand due to employment growth.

Various concepts of job openings and replacement needs have been put forward in the literature. Different concepts lead to different estimates. The two commonly used concepts of replacement needs are:

- *gross replacement*, meaning the total number of jobs arising from any individual leaving an occupation; and
- *net replacement*, meaning the number of jobs arising from individuals leaving net of those re-entering an occupation, in essence the jobs available for new entrants.

The appendix to this report provides more detailed definitions of replacement, an explanation of the ways of estimating net replacement and some details of the MONASH model.

Job openings

Job openings in an occupation are defined to be the result of *gross* replacement and growth. They provide indications of job opportunities for all those who are contemplating employment in the occupation, including those returning to it. If there is no growth in an occupation or employment declines then all the job openings are a result of gross replacement. Estimates of job openings are used by the Department of Employment and Workplace Relations in their advice on employment prospects (DEWR 2002).

Net job openings

Net job openings in an occupation are a result of *net* replacement needs and growth. They provide an estimate of the number of jobs available in an occupation to those entering it for the first time. Such information provides an indication of the *minimum* training requirements, assuming training is needed, and hence is useful in formulating training policy. For this reason it is net job openings that are the focus in this report.

In passing it can be noted that these estimates of job openings do not provide any indication of the further training or retraining of persons already in an occupation and the training of those who are under-skilled. Such training needs are additional to any based on the estimation of job openings.

Scope of the forecasts

This rest of this section provides projections of employment growth; net replacement needs and net job openings across the nine occupational groups as discussed earlier.

The growth forecasting model and the net replacement needs model are used to make estimates at the Australian Bureau of Statistics classification of occupations at the four-digit occupation level. The estimates for the nine occupational groups are aggregates of these forecasts. In the following sections brief descriptions of the growth forecasts and net replacement needs are presented before providing summary results. Finally, forecasts of job openings for new entrants in the nine occupational groups are presented.

Growth

Growth forecasts are made using the MONASH model, a dynamic computational general equilibrium model, developed by the Centre of Policy Studies (CoPS). Full description of the model is beyond the scope of this paper but some details are provided in the appendix.

The growth forecasts that are comparable with the latest available net replacement forecasts were made in December 2001 with the base period 2001. They incorporate, among other information, Access Economics' September 2001 quarter *Five Year Business Outlook* of the Australian economy and other recently released data from the Australian Bureau of Agricultural and Resource Economics (ABARE), the Tourism Forecasting Council (TFC), the Productivity Commission (PC).

MONASH converts the forecast for aggregate output to forecasts for output by industry. These are then converted to forecasts of employment by industry, which in turn are finally converted to employment by occupation. Employment growth for a particular occupation can be decomposed into three components:

- growth in aggregate employment;
- industry share effect (result of changes in distribution of employment across industries); and
- occupation share effect (result of changes in the distribution of employment across occupations within industries).

We have aggregated the employment forecasts at the ASCO four-digit occupations from the MONASH model to obtain forecasts for the nine groups discussed earlier. These forecasts are presented in Table 1.

Overall employment is forecasted to grow by 571 000 jobs or 1.2 per cent per annum over the five years to 2006. There is little difference in the average annual growth rate in employment of globally advantaged occupations (1.8 per cent) and of insulated occupations (1.7 per cent), but the rate for vulnerable occupations (0.5 per cent) is less than a third of the rate of the first two groups.

The two sub-groups that make up the globally advantaged occupations, conceptual and technical, have very similar rates of growth. On the other hand the rates vary substantially amongst the three sub-groups of insulated occupations. The rate for the low-skill sub-group is the highest while that for the professional sub-group is the lowest. Similarly, substantial differences are evident amongst the rates for the four sub-groups of vulnerable occupations. Advanced skill workers—mainly the trade occupations—are forecast to grow only at 0.2 per cent per annum and blue-collar workers employment is forecasted to grow scarcely at all. The highest growth rate in vulnerable occupations is for manual low-skill jobs with a rate of 0.8 per cent per annum.

The large variation across sub-groups of insulated and vulnerable occupations indicates the importance of looking at sub-groups, and perhaps also within sub-groups, to gain an understanding of the dynamics of job creation and destruction.

Table 1 Forecasts of employment growth forecasts in 2002-06 by the nine occupational groupings

Occupational grouping	Employment 2001('000)	Growth '000	Growth Average annual rate (%)
All Occupations	9 090.4	570.9	1.2
Globally advantaged occupations	*1 993.6*	*191.1*	*1.8*
Conceptual	1 478.6	144.0	1.9
Technical	515.0	47.1	1.8
Insulated occupations	*3 344.5*	*290.2*	*1.7*
In-person professional	758.8	53.4	1.4
In-person skilled	1 274.3	109.4	1.6
In-person low-skill	1 311.4	127.4	1.9
Vulnerable occupations	*3 752.3*	*89.6*	*0.5*
Advanced skill	1 030.0	12.7	0.2
White-collar	1 046.0	34.3	0.6
Blue-collar	664.2	1.9	0.1
Manual low-skill	1 012.0	40.7	0.8

Note: Growth forecasts are reproduced here with permission from the Centre of Policy Studies, CoPS, Monash University.

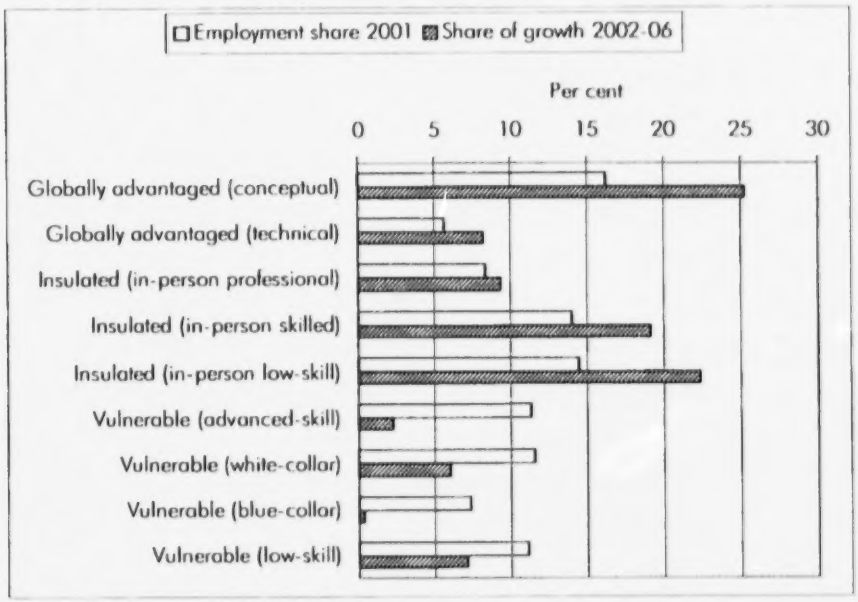
An alternative way to view the employment growth data is to consider the shares of total growth across the nine sub-groups. Figure 2 compares the shares in growth over 2002-06 period with employment shares at 2001 in the nine sub-groups. The figure clearly shows globally advantaged occupations and the insulated occupations share the bulk of the employment growth that is forecasted for the 2002-06 period. In 2001 the two groups' share of employment was 59 per cent while their share of growth over the forecast period is expected to be 84 per cent.

Shares of employment growth vary significantly across the nine groups. The conceptual sub-group within the globally advantaged occupations has the highest share of growth (25 per cent). Employment in this sub-group in 2001 was only 16 per cent of the total so its share of total employment is rising. The technical sub-group's share of forecasted growth is also much higher than its share of employment in 2001.

Among the insulated occupations the share of growth in the in-person professional sub-group is commensurate with its share of employment in 2001. In-person skilled and in-person low-skill sub-groups' shares of total growth are 19 and 22 per cent, respectively, while their shares of employment in 2001 are each about 14 per cent. So they are increasing their shares of total employment quite markedly.

In contrast, the shares of growth of all sub-groups of the vulnerable occupations are substantially lower than their respective shares of employment in 2001. In particular, the blue-collar workers' share of growth is negligible. Similarly the advanced skill sub-group's share of growth is 2 per cent while its share of employment in 2001 was 12 per cent.

Figure 2 **Share of employment in 2001 compared with the share of employment growth in 2002-06 for the nine occupational groupings, Australia**



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Net replacement needs

Net replacement needs are estimated with unpublished data from the Australian Bureau of Statistics (ABS), mainly from the *Labour Force* survey. Net replacement needs in an occupation are job openings for new entrants resulting from individuals leaving the occupation net of those re-entering. The method of estimating net replacement needs is reported in Shah & Burke (2001) and a brief overview is given in the Appendix to this report.

Forecasts for Australia for the period 2002-06 are given in Table 2. Overall job openings due to net replacement needs are estimated to be just under one million over five years, or at an average annual rate of 2.1 per cent. The net replacement rate is nearly twice that of growth n employment.

The rate of replacement in insulated occupations (2.6 per cent) is the highest while that in globally advantaged occupations (1.5 per cent) is the lowest. It averages about 2.0 per cent for the vulnerable occupations. These rates reflect the age and gender profile of the respective groups and the average job tenure within these groups.

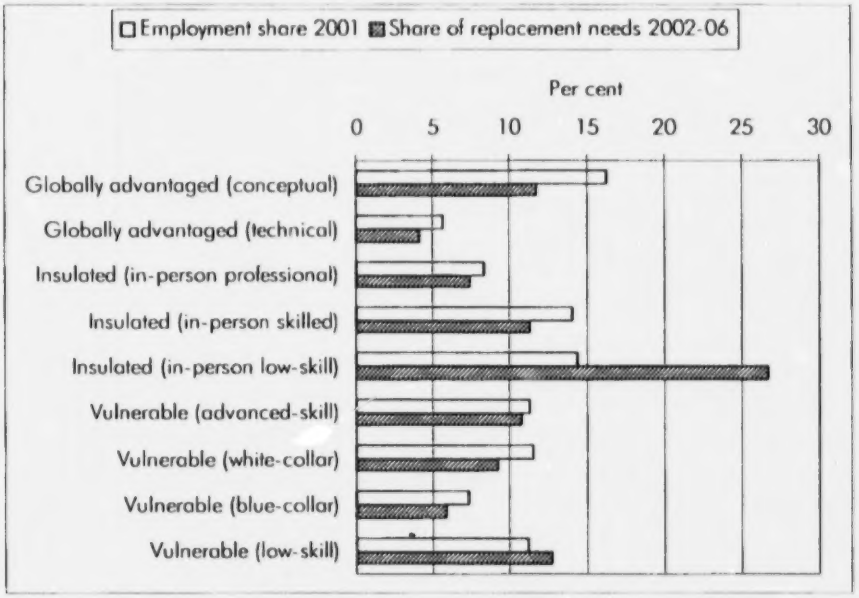
While both of the globally advantaged sub-groups have similar low net replacement rates of 1.5 per cent, the rates vary across all other sub-groups. It is highest for insulated in-person low-skill sub-group. The very high rate for this sub-group reflects the extremely high turnover of workers such as waiters and cashiers and checkout operators in which mostly young people, many of whom are still at school, are employed. These jobs are often part-time and casual in nature. For many young people such jobs provide income support while they study to qualify for alternative jobs. This is a matter for later consideration.

Table 2 Forecasts of net replacement needs in 2002-06 by the nine occupational groupings

Occupational grouping	Employment 2001('000)	Net replacement	
		'000	Average annual rate (%)
All Occupations	9 090.4	993.7	2.1
Globally advantaged occupations	*1 993.6*	*158.1*	*1.5*
Conceptual	1 478.6	116.9	1.5
Technical	515.0	41.2	1.5
Insulated occupations	*3 344.5*	*451.2*	*2.6*
In-person professional	758.8	73.2	1.9
In-person skilled	1 274.3	112.6	1.7
In-person low-skill	1 311.4	265.4	3.9
Vulnerable occupations	*3 752.3*	*384.4*	*2.0*
Advanced skill	1 030.0	107.1	2.0
White-collar	1 046.0	91.7	1.7
Blue-collar	664.2	58.8	1.8
Manual low-skill	1 012.0	126.7	2.4

Figure 3 shows each sub-group's share of the total net replacement needs. About 27 per cent of all job openings due to replacement needs can be expected in the insulated in-person low-skill occupations, which had just 14 per cent of total employment in 2001. It also shows that the vulnerable low skill jobs have an above average rate of replacement which, in terms of job creation, partly offsets the low growth in numbers projected in such jobs.

Figure 3 **Share of employment in 2001 compared with the share of net replacement needs in 2002-06 for the nine occupational groupings, Australia**



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Job openings for new entrants

Forecasts of net job openings for new entrants are obtained by adding growth to net replacement needs. If growth in an occupation happens to be negative or zero then job openings in that occupation are a result of replacement needs only.

Table 3 includes forecasts of job openings in the nine occupational groups. Job openings in the advantaged occupations are, because of their low replacement rates, only in line with their share of employment in 2001. The low replacement rate offsets the high growth rate in numbers employed.

Job openings in insulated occupations are forecasted at a rate that is above average for all occupations. Large growth combined with high turnover means that job openings in insulated in-person low-skill occupations are expected to grow at the substantial rate of six per cent per annum in 2002-06.

In vulnerable occupations job openings are expected to be at a below average rate. In the vulnerable white-collar and blue-collar occupations job openings are expected to average less than three per cent per annum, most as a result of net replacement of workers, not of growth in employment.

Table 3 Forecasts of job openings for new entrants in 2002-06 by the nine occupational groupings

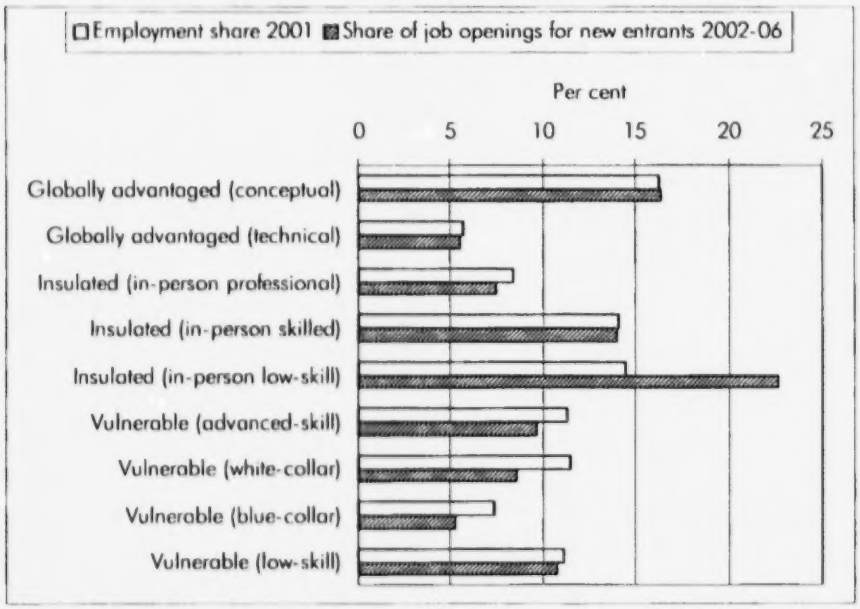
Occupational grouping	Employment 2001('000)	Net replacement	
		'000	Average annual rate (%)
All Occupations	9 090.4	1806.6	3.8
Globally advantaged occupations	*1 993.6*	*158.1*	*3.8*
Conceptual	1 478.6	295.8	3.8
Technical	515.0	99.1	3.7
Insulated occupations	*3 344.5*	*394.9*	*4.6*
In-person professional	758.8	134.0	3.4
In-person skilled	1 274.3	252.3	3.8
In-person low-skill	1 311.4	408.5	6.0
Vulnerable occupations	*3 752.3*	*616.9*	*3.2*
Advanced skill	1 030.0	173.7	3.3
White-collar	1 046.0	154.8	2.9
Blue-collar	664.2	94.5	2.8
Manual low-skill	1 012.0	193.8	3.7

Figure 4 shows the shares of job openings related to the shares of employment in 2001. About 23 per cent of all job openings for new entrants in 2002-06 are expected to be in the insulated in-person low-skill occupations whereas they made up only 14 per cent of total employment in 2001.

The shares of job openings in vulnerable occupations in the white-collar and blue-collar sub-groups are forecast to be less than their share of employment in 2001. However for the trades and especially for the low skill groups, the above average rate of replacement lifts their share of job openings closer to their share of employment.

The share of job openings for the insulated in-person professional sub-group is also a little less than its share of employment in 2001. The relatively low rate of replacement offsets the higher rates of growth among the globally advantaged occupations so their share of job openings is close to their share of employment in 2001.

Figure 4 **Share of employment in 2001 compared with the share of job openings for new entrants in 2002-06 for the nine occupational groupings, Australia**



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Conclusion

Maglen's studies of employment have been aimed at understanding the effects of globalisation and technological change and the consequent implications for education and training. This paper takes the analysis further by considering forecasted changes in employment and also the effects of labour turnover.

The classification of occupations used is based on the extent to which globalisation and technological change exposes workers to international markets. Some groups of occupations can be seen to be advantageously exposed but others are vulnerable to having overseas production substituted for their work. A third group of occupations, largely in-person service work can be seen to be insulated from the international forces.

The groups of occupations seen to be 'globally advantaged' are further grouped into those called 'conceptual' and 'technical'. Examples of those globally advantaged are many of the professionals and associate professionals in business related occupations. The insulated occupations include many of the 'in-person service' professional occupations but also some skilled and low skill occupation for which overseas workers or products cannot be readily substituted. The vulnerable occupations are those whose services, or the products they make, are most subject to substitution from abroad or by new technology and include many manufacturing workers both skilled and less skilled and also some groups of white collar workers.

Overall growth in employment is expected to be 1.2 per cent per year for 2002-06. Net replacement, the jobs resulting from replacement of workers who leave a job net of re-entrants to the occupation, is expected to be 2.1 per cent.

More than four out of every five jobs that are generated because of growth in employment are projected to be in the globally advantaged occupations or in the insulated occupations. These groups of occupations have projected average growth rates to 2006 of about 1.7 per cent per annum whereas the average for the vulnerable occupations is only 0.5 per cent per annum. Over time the share of total employment in the vulnerable occupations is therefore projected to decline.

However because of job turnover there still will be a substantial number of job openings for new entrants in these vulnerable occupations. The net replacement rate for the vulnerable occupations is 2.0 per cent, just about at the average for all occupations and higher than for most of the globally advantaged occupations. Hence the job openings and the training needs for these occupations are not as low as an analysis confined only to growth in employment would imply.

The insulated occupations which have above average growth in employment also have a relatively high rate of turnover, especially among the low skill groups of insulated occupations. More than one in every five job openings for new entrants over the next few years is expected in 'in-person' *low skill* insulated occupations.

This emerging pattern of job openings can provide part of the information for needed for considering the future pattern of training though not all. As noted they do not provide any indication of the further training or retraining of persons already in an occupation and the training of those who are under-skilled. Such training needs are additional to any based on the estimation of job openings.

The implications of the current analysis VET sector include:

- The VET sector should continue to make strategic decisions to develop capacity to deliver training in areas that have potential growth in the future. This includes a number of the associate professional fields.
- Even though there is little projected growth in some of the vulnerable occupations for which the VET sector is the primary source of training there continue to be substantial job openings for new entrants due to replacement of workers leaving the occupations. This is true for the skilled trades for example. It is therefore important for the VET sector to maintain capacity to provide training in these fields.
- Close consideration can be given to the training of in-person low-skill occupations that have high growth but also very high job turnover.
    - What resources go into training for these occupations for which tenure may be quite short for many young people?
    - Is the training provided useful for the occupations many of the persons in these jobs may later enter?
    - Who bears the costs of the training, who receives the benefits and who pays for it: employers, employees and government?

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Appendix: Replacement demand and growth

Concepts of replacement

The concepts can be explained with the aid of Figure A1, which represents the gross flows of individuals in and out of an occupation *O* in a given period. Gross outflows from occupation *O* in period (*t-n*, *t*) are *B*, *C*, and *D*, while *E*, *F*, *G*, *H*, *I* and *J* represent inflows. *A* represents stayers in occupation *O*, those who did not move out of the occupation in this period. It includes those who may have changed jobs but not occupation. *B* represents all those who leave the occupation to a job in other occupations, *C* the numbers moving from occupation *O* to unemployment while *D* includes all flows out of the labour force including emigration and deaths.

Individuals enter an occupation *O* from three major sources, from other occupations (*E* and *F*), from unemployment (*G* and *H*) and from outside the labour force including immigration (*I* and *J*). From each of these sources individuals can be either new entrants or re-entrants to occupation *O*. New entrants are persons entering the occupation for the first time. Re-entrants are those individuals who are returning to occupation *O*, after previously leaving it voluntarily or due to job termination.

Figure A1 Gross flows from and into an occupation

	To at time *t*			
From at time *t-n*	Occupation O	Other occupations	Unemployment	Outside labour force
Occupation O	*A*	*B*	*C*	*D*
Other occupations (new entrants)	*E*			
Other occupations (re-entrants)	*F*			
Unemployment (new entrants)	*G*			
Unemployment (re-entrants)	*H*			
Outside labour force (new entrants)	*I*			
Outside labour force (re-entrants)	*J*			

Gross replacement

Gross replacement is a measure of the total number of job openings resulting from individuals leaving an occupation, including those who change occupations or leave employment. In terms of the component flows in Figure A1, gross replacement is the sum of the outflows *B*, *C* and *D* if employment expands in an occupation. If employment contracts it is the sum of the outflows *B*, *C* and *D* less the decline in employment because not all those who leave are replaced, or alternatively it equals the sum of inflows *E*, *G*, *H*, *I* and *J*.

Net replacement

Net replacement needs in an occupation are job openings for new entrants as a result of individuals leaving the occupation net of those re-entering. In terms of the flows in Figure A1, net replacement is the sum of the outflows *B*, *C* and *D* less re-entrants *F*, *H* and *J* to the occupation. Just as for total replacement, if employment declines then net replacement equals the sum of the outflows less the decline in employment and less the sum of re-entrants, because not all those who leave are replaced.

Estimating Net Replacement

The details of the method adopted for this report are basically those in Shah and Burke (2001).

Separate information on re-entrants and new entrants is unavailable in the Australian Bureau of Statistics (ABS) (1992 *Labour Mobility* survey but it is possible to approximate the category of new entrants by using a method of estimation applied to the data available in the *Labour Force* survey.

Such a method of estimation is the cohort-component method. The cohort-component method has been widely used for calculating survival ratios in demography Australian Bureau of Statistics (ABS) (1992); Davenport and O'Leary (1992; Kippen and McDonald (2000; Pollard, Yusuf and Pollard (1974; Shryock and Siegel (1980). It has been used to calculate student progression rates through courses in higher education (Shah and Burke (1999) and wastage rates in health manpower studies (Office of International Health (1979). Eck (1991) and Willems and de Grip (1993) have used the method to calculate occupational net replacement needs in the US and the Netherlands, respectively.

To explain how the cohort-component method can be used to approximate net replacement first, net outflows are defined. Suppose for simplicity that the annual employment data in an occupation are available by five-year age groups, E_{at} represents the size of cohort of age a at time t and $E_{a+5,t+5}$ represents the size of the same cohort five years later. Then the net five-year flow from this cohort is represented by the change in the size of the cohort over this period. In other words, it is given by:

$$F_{at} = E_{a+5,t+5} - E_{at}.$$

If the size of the cohort has decreased ($F_{at} < 0$) then we say there has been a net outflow of ($-F_{at}$), otherwise the net outflow is zero.

In most occupations there are likely to be more leavers from older aged cohorts than there are entrants. Furthermore, new entrants to an occupation are likely to be found

mainly in the younger cohorts and re-entrants mainly in the older cohorts. Consequently net outflows from the older aged cohorts are more likely to be positive, and will be made up of leavers less (mostly) re-entrants. The sum of the net outflows over all cohort components approximates the number of leavers from an occupation less (mostly) re-entrants, and thus provides an estimate for net turnover or replacement needs in the occupation.

The above is true if employment in the occupation has been expanding. On the other hand if employment has been declining, then the sum of the net outflows is reduced by the contraction in employment, because in this case not all those who leave are replaced.

Growth: the Monash Model

Details of the methodology underpinning the model and its assumptions can be found in Adams, Dixon, McDonald, Meagher and Parmenter (1994), Dixon and Rimmer (1996), Meagher (1997) and Dixon and Rimmer (2000). An intuitive description of the model is contained in Appendix O of Industry Commission (1997).

In brief, MONASH is a sequence of single-period models, linked through time by the behaviour of capital and labour markets. It has three main elements—a database, theory and parameters—which are embodied in the model's system of equations. These equations describe how industries and consumers respond to changes in policy. The core of the database is a large input-output matrix showing how each sector of the economy is linked to every other sector. These linkages are only for a particular point in time. Behaviour responses of different groups to policy changes are determined on the basis of economic theory. The model provides specification of likely responses of producers, consumers, foreigners and investors to policy changes. It also includes a government sector, the revenue and expenditure behaviour of which is modelled separately. While theory guides the model's broad assumptions (which can be altered to accommodate different scenarios), actual numerical parameters are required to estimate the size of the responses. In MONASH these parameters are either derived from the input-output database or other external sources.

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